A three-year aerobiologic pollen survey of the Tampa Bay area, Florida

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An aerobiologic survey using a rotoslide sampler was conducted daily (January 1979 through December 1981) in Tampa, Florida.

A major tree pollen season (Dec. through May) consisted of oak, pine, Australian pine, bald cypress, cedar, bayberry and mulberry. A minor tree season (Oct. and Nov.) consisted of Australian pine and elm. Grass pollen was found throughout the year and most prevalent April through October. A major weed pollen season (May through Dec.) consisted of ragweed, Mexican tea, pigweed, dog fennel, and false nettle. A minor weed season (March through July) consisted of sorrel and dock.

INTRODUCTION

Aerobiologic surveys, with particular attention to pollens, have been carried out for many years in various locations throughout the United States. The Pollen and Mold Committee of the American Academy of Allergy and Immunology publishes a yearly report from over 60 counting stations in the United States and five other countries.[1] State and county health departments, hospitals, and specialists use data on the quantity and type of aeroallergens present in a particular area at a specific time to determine which aeroallergens may cause patient distress.[2,3]

This aerobiologic survey was conducted for the following reasons. First, although most of the information included in allergy texts[3–6] on Florida aeroallergens is accurate, some of it is misleading. Second, distinct regional differences in Florida necessitate independent investigation in each area.[7]

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The Tampa Bay area has many ecologic characteristics of subtropical Florida, the lower one-third of the Florida peninsula, as well as those of the warm temperate zone of north Florida. The flora include a number of species introduced from other subtropical countries such as Australian pine (*Casuarina*), bottlebrush (*Callistemon*), eucalyptus (*Eucalyptus*), Brazilian pepper tree (*Schinus*), mulberry (*Broussonetiamorus*), Siberian elm (*Ulmus pumila*), Chinese elm (*Ulmus parvifolia*), and the punk or cajeput tree (*Melaleuca*).

Aerobiologic studies have been done in Miami on the southeast coast of Florida,[8,9] in Sarasota on the southwest Gulf Coast,[10] and in Orlando in central peninsular Florida[7]; however, none has been done in the densely populated Tampa Bay area, population 2.1 million, on the central Gulf Coast.

METHODS

This aerobiologic survey was conducted daily by the Division of Allergy and Immunology at the University of South Florida College of Medicine and the James A. Haley Veterans Administration Hospital, Tampa, Florida. A rotoslide sampler (Aquebogue Machine and Repair Shop, Box 205, Main Road, Aquebogue, Long Island, NY) was mounted on the roof of a 3-story building (the Veterans Administration Hospital in Tampa, Florida) located in an area of typical regional flora, a combination of both native and introduced plants. The location had neither a close source of industrial air pollution nor obstruction by large buildings or other obstacles of prevailing winds from any direction.

The rotoslide sampler was an electrically operated model that collected for one of every 12 minutes. General Electric G-697 silicone grease was applied to the edges of each slide. The slides were changed daily at approximately 7:30 A.M. When slides were not changed every 24 hours such as on weekends or holidays, the count was divided by the number of exposed days.

The rotoslides were stained with modified Calberla's solution and the entire surface was counted at x450 magnification using standard procedures.[4,5,11,12] The unit volume of air sampled was determined by multiplying: (1) the sample time by (2) the volume of air sampled per revolution and (3) by the revolutions per minute. Air sampled = 120 min $\times$ 0.00005 m^2 $\times$ .377 m/revolution $\times$ 1550 rpm = 3.5 m^3. The data are reported as the weekly average $\pm$ 1 STD grains/m^3 for each of the 1 to 52 weeks, 1979–1982, ie:

Week 1 (1979) (day 1 + day 2 + . . . day 7) grains/m^3
+
Week 1 (1980) (day 1 + day 2 + . . . day 7) grains/m^3
+
Week 1 (1981) (day 1 + day 2 + . . . day 7) grains/m^3
21 Days

Correlation of rotoslide findings with plant pollen production were made by field observations every four to seven days during the flowering season of a particular plant or group of plants.

Plants of the Tampa Bay Area[13] and other references on Florida flora[14–18] were used to determine the genera of local flora. Standard references[4,5,11,12,19–24] were utilized for microscopic identification of pollen and spores. Permanent reference slides were made of pollen from species collected in the field.

RESULTS

Based on air sampling, the most prolific sources of airborne tree pollens, listed in magnitude of production, in the Tampa Bay area are oak (*Quercus*), pine (*Pinus*), cypress (*Taxodium*), cedar (*Juniperus*), Australian pine (*Casuarina*), bayberry (*Myrica*), and mulberry (*Broussonetia-Morus*) (Fig 1).

Oak

There are eleven species of oak (*Quercus*) according to the literature and confirmed by field studies in the Tampa Bay area. Listed in order of abundance they are: laurel (*Q. laurifolia*), sand live (*Q. geminata*), turkey (*Q. laevis*), blue-jack (*Q. incana*), live (*Q. virginiana*), myrtle (*Q. myrtifolia*), water (*Q. nigra*), Chapman's (*Q. chapmanii*), dwarf live (*Q. minima*), running (*Q. pumila*), and scrubby post-oak (*Q. stellata* var *margaretta*). The flowering season for the oaks is December through May, with the counts consistently highest during March and April.

Pine

The two most abundant species of pines (*Pinus*) in the Tampa Bay area are the slash pine (*P. elliottii*) and the longleaf pine (*P. palustris*). Pine pollen was found from December through June with the highest counts in February and March. The year 1980 was particularly favorable for pine pollen production in the Tampa Bay area.

Cypress and Cedar

The cypress and cedar pollen count is the total of similar appearing *Juniperus*-type pollen from two families, *Taxodiaceae* and *Cupressaceae*. There are two species of *Taxodium* in the Tampa region, bald cypress (*Taxodium distichum*) and pond cypress (*T. ascendens*). The latter species is sometimes regarded as a variety of the first, ie, *T. distichum* var. *imbricaria*. One species, southern red cedar (*Juniperus silicicola*), of the cypress family (*Cypressaceae*) is found in the Tampa Bay area. *Taxodium ascendens* is much more abundant than either *T. distichum* or *J. silicicola* in the Tampa Bay area. Accordingly, it has been assumed that most of the pollen in the cypress and cedar category is *Taxodium*. The cypress-cedar pollen season extends from December through March and peaks in January, February and March. March of 1981 showed a notable increase in count compared to the same month in the previous 2 years.

Australian Pines

There are two species of Australian pine in the Tampa Bay area, *Casuarina equisetifolia* and *C. cunninghamiana*. Both are widely planted and naturalized species from Australia. They are not true pines, but belong to the beefwood family, Casuarinaceae. *Casuarina* produces pollen in the spring (February through April) and in the fall (October through December) and may pollinate intermittently throughout the year south of the Tampa Bay area. Counts were about the same each spring but the pollen count for October 1979 was double that of any other month (spring or fall) in the 3-year study.

Bayberry

One species of bayberry or wax myrtle grows in the Tampa Bay area, *Myrica cerifera*. Pollen production occurs in February, March, and April, with March the month with the largest count.

Mulberry

Due to the morphologic similarity of pollen from the paper mulberry (*Broussonetia papyrifera*) and red mulberry (*Morus rubra*), the total counts for mulberry include both species. *Broussonetia*, native to eastern Asia and Polynesia, is commonly planted and naturalized in the Tampa Bay area. Flowering usually occurs March through June with peak pollen counts during March.

The remaining trees have weekly average pollen counts less than ten and shorter, less predictable blooming periods. They are discussed in order of abundance.

Elm

There are three species of elm (*Ulmus*) in the Tampa Bay area. White or American elm (*Ulmus americana*) and Siberian elm (*U. pumila*) bloom from January to March. The Chinese elm (*U. parvifolia*) blooms from September through December. *Ulmus americana* is native while the cultivated *U. pumila* and *U. parvifolia* were introduced from Asia.

Other Trees

The sweet gum (*Liquidambar styraciflua*) flowers in February and March. The March 1981 count was approximately a 5-fold increase over total counts of the previous 2 years.

The Tampa Bay area has two species of hickory (*Carya*): water hickory (*C. aquatica*) and pignut (*C. glabra*). Scrub hickory (*C. floridana*) is a rare third species. The pollen production time for *Carya* is from February through May.

Southern red maple (*Acer rubrum*

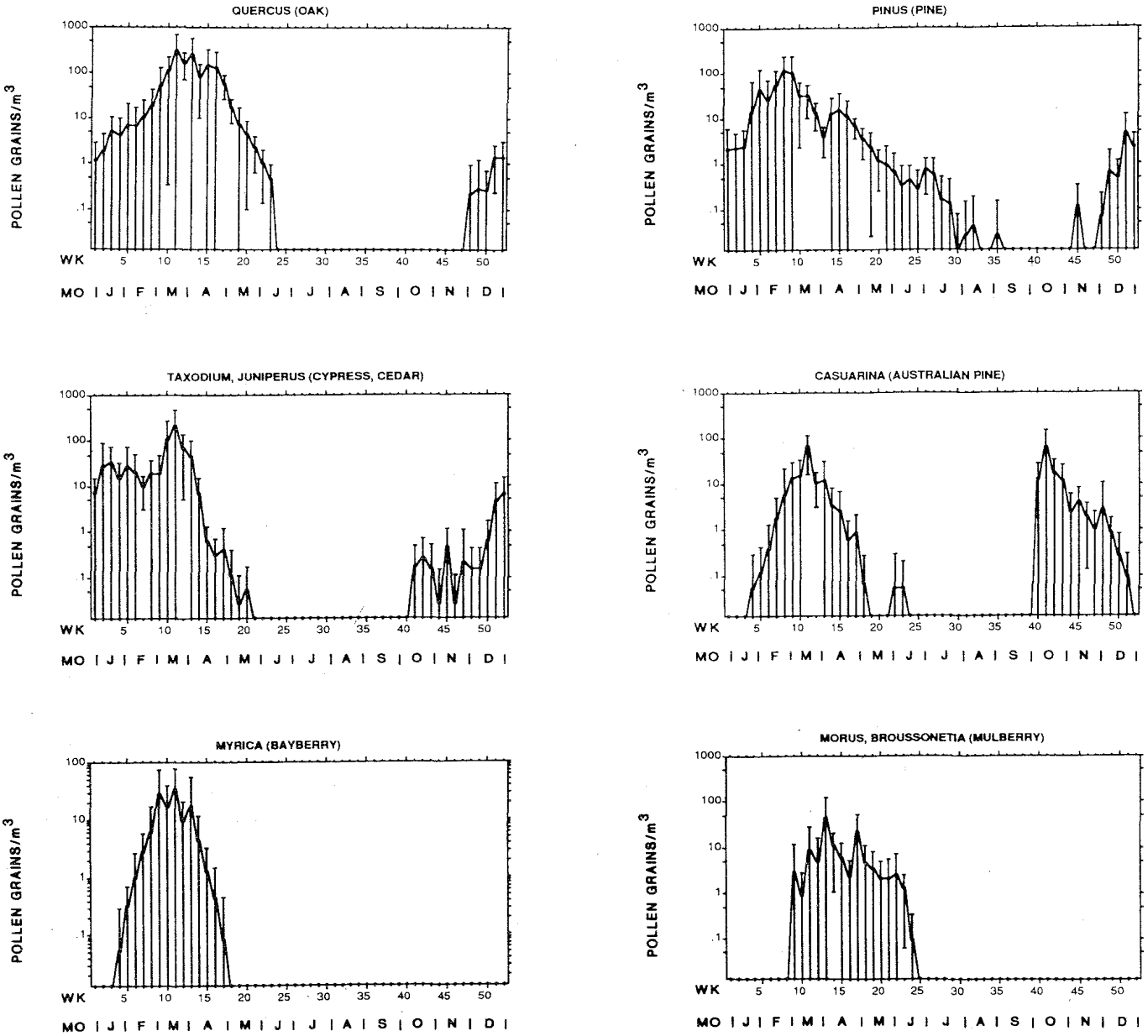

Figure 1. Tree pollen counts, weekly mean ± 1 SD, grains/m^3 are sampled daily 1979–81 by Rotoslide®, University of South Florida College of Medicine, James A. Haley Veterans Hospital, Tampa, Florida.

var. *trilobum*) is present in the Tampa Bay area. It flowers January through March, although in 1979 the pollen appeared as late as April.

The water ash (*Fraxinus caroliniana*) is a winter pollen producer in Florida, flowering December through February.

The southern willow (*Salix caroliniana*) grows around lakes, waterways and ponds in the Tampa Bay area. It usually flowers for two to three weeks in February but in 1979 and 1980 some pollen appeared in late January.

The punk tree, cajeput tree or paper-bark tree (*Melaleuca quinquenervia*), is native to Australia and has become well established in the Tampa Bay area. It is primarily insect pollinated and flowers any time except during freezing weather. These multiple bloomings produce little if any airborne pollen since the

weekly average pollen count was never more than 1 grain/m^3.

The herbaceous weeds of the Tampa Bay area flower primarily April through November (Fig 2). But, this is variable, ie, in 1981, weed pollens were recorded throughout the year.

Ragweed

Pollen counts for individual weed species vary as widely as do the tree pollen counts. Common or short ragweed (*Ambrosia artemisiifolia*) is the sole species responsible for this prolific production of ragweed pollen in the Tampa Bay area. Another species, coastal ragweed (*A. hispida*) is found on the Florida Gulf Coast. Ragweed is the source of 65% to 91% of the total weed pollen during the four major weed pollen production months, August through November. A lesser but significant amount of ragweed pollen, however,

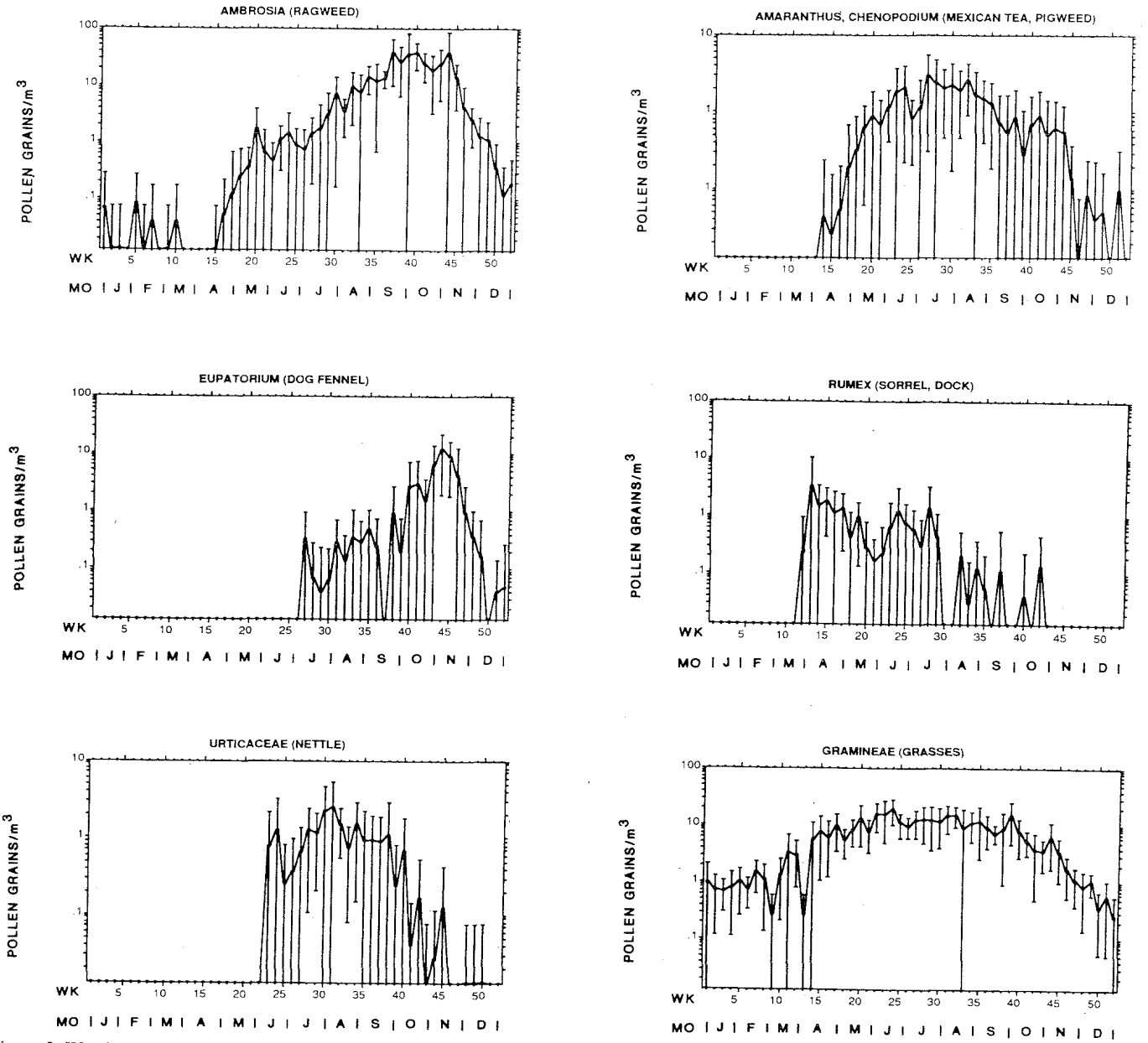

Figure 2. Weed and grass pollen counts, weekly mean ± 1 SD, grains/m^3 are sampled daily 1979–81 by Rotoslide®, University of South Florida College of Medicine, James A. Haley Veterans Hospital, Tampa, Florida.

was detected from May through July.

Amaranthus pollen resembles *Chenopodium* pollen and thus are counted together. Common pigweed (*Amaranthus hybridus*) and spiny pigweed (*A. spinosus*) are the most common members of the genus in the Tampa Bay area. Other species are present, but in fewer numbers. There are two species of *Chenopodium*: Mexican tea (*C. ambrosioides*) and goosefoot or lamb's quarters (*C. album*). Mexican tea is the predominate species. These chenopods occur frequently in citrus groves and are more numerous than *Amaranthus* species in the region. *Atriplex arenaria* and *Suaeda linearis* probably contribute little to the *Amaranthus* and *Chenopodium* counts since they occur primarily along the coastal and salt marsh areas. The pollen production season for *Amaranthus* and *Chenopodium* extends from May through November with high counts during the summer months.

Dog Fennel

Dog fennel, *Eupatorium*, is widespread in the Tampa area with profuse growth in disturbed sites, ie, fields and along roadsides. Three species, *E. capillifolium*, *E. compositifolium* and *E. leptophyllum* are present. Some pollen production occurs in late summer, but the higher counts occur in October and November. Dog fennel is both insect and air pollinated. *Baccharis halimifolia* has similar appearing pollen and may have been counted in with the *Eupatorium*. *Parthenium hysterophorus* could also contribute to the *Eupatorium* pollen count and is common in the Tampa Bay area.

Rumex

The docks and sorrel are counted together and belong to the genus *Rumex*. Sorrel (*R. hastatulus*) and the docks, primarily *E. verticillatus*, are spring pollinators with production beginning in March or April and continuing into July.

Other Pollens

Urticaceae pollen grains found on the samples in late summer (July through October) may be bog hemp or false nettle (*Boehmeria*) and/or clearweed (*Pilea*). Pellitory (*Parietaria*), which flowers from January to June, was not detected in this survey but found on subsequent surveys.

Common cattail (*Typha latifolia*) and Southern cattail (*T. domingensis*) grow in freshwater sites throughout the area. Trace amounts of cattail pollen was detected March through May. The highest daily pollen count was only 2 grains/m^3.

There are six species of goldenrod in the Tampa area, the most common of which are *Solidago sempervirens*, *S. chapmanii* and *S. fistulosa*. *Euthamia minor* is abundant and its pollen is indistinguishable and included in *Solidago* pollen counts. October and November were the only months when *Solidago* pollen was detected. The highest daily count was only 3 grains/m^3.

Grass pollen is present all year, but April through October is the period of heaviest pollen production (Fig 2). Members of the grass family (Gramineae) in order of abundance in the Tampa Bay area are: Bahia grass (*Paspalum notatum*), Bermuda grass (*Cynodon dactylon*), Vasey grass (*Paspalum urvillei*), Natal grass (*Rhynchelytrum repens*), St. Augustine grass (*Stenotaphrum secundatum*), beard grass (*Andropogon spp.*), Guinea grass (*Panicum maximum*), and Johnson grass (*Sorghum halepense*). Of these, only *Stenotaphrum* and *Andropogon* are native to the Tampa Bay area. Rye grass (*Lolium perenne*) is planted in lawns and may be a minor contributor to the total grass pollen count.

DISCUSSION

This 3-year aerobiologic survey identifies the usual pollen producing seasons in the Tampa Bay area for trees, herbaceous weeds, and grasses (Figs 1 and 2).

The tree pollen production season of the Tampa Bay area differs in three ways from most northern parts of the country. First, the tree pollen season lasts longer, October to June. Second, pollen production for individual species is earlier: December for oak, pine, cypress, cedar, and ash; January for maple and willow; February for bayberry, sweet gum, and hickory; and early March for mulberry. Third, some genera bloom more than once a year: Australian pines (*Casuarinaceae*) bloom at least twice a year, February to April and October to November; elms (Ulmaceae) *U. americana* and *U. pumila*, January to April, and *U. parvifolia*, September to October. The punk or paper-bark tree (*Melaleuca*) blooms intermittently throughout the year but its pollen is scarcely airborne.

Nasal and bronchial challenge studies conducted at our institution have shown bald cypress (*Taxodium distichium*), Australian pine (*Casuarina equisetifolia*), and bayberry (*Myrica cerifera*) pollens to be aeroallergens.[25–27] Oak, elm, ash and hickory pollen have been studied by various investigators and found to be significant aeroallergens.[2–5,28,29] Oak pollen counts were the highest of any genera including grasses and weeds. Punk, maple, willow, and sweet gum are primarily insect-pollinated and therefore do not produce large amounts of aeroallergens. The punk tree pollen has been considered an important aeroallergen[30]; however, double-blind controlled studies reveal that neither punk tree pollen nor odor from its blossoms causes respiratory symptoms.[31]

The importance of slash pine (*P. elliotti*) and longleaf pine (*P. palustris*) as sources of aeroallergens is unknown for lack of well controlled studies. A study conducted in Rhode Island has found a 10% incidence of positive prick skin tests using eastern White pine (*P. strobus*) pollen extract in patients with spring seasonal allergic rhinitis. Four patients with positive prick

skin tests with eastern white pine pollen extract had nasal challenges with the same extract, two of them had positive challenges.[32]

Negligible amounts of pollen from the following species were observed: pecan (*Carya illinoinensis*), box elder (*Acer negundo*) sycamore (*Platanus occidentalis*), walnut (*Juglans sp*), and cottonwood (*Populus deltoides*). There was no pollen detected from other tree species which are alleged sources of aeroallergens in the Tampa Bay area such as Brazilian pepper (*Schinus terebinthifolius*) and mangroves (*Rhizophora mangle, Laguncularia racemosa*, and *Avicennia germinans*).

The herbaceous weed pollen season extended from April through November in 1979 and 1980. Weed pollen grains, however, were present during every month of 1981. Flowering ragweed, pigweed, and Mexican tea have all been observed in the field during the three presumably weed pollen-free months (January, February, and March). Weed pollen production in other parts of the United States begins later and lasts until the first frost.

Ragweed is the most abundant wind pollinated weed found in the Tampa Bay area, but during the peak pollen season (August to November), the concentration of the ragweed pollen is less than in the eastern and midwestern United States.[1]

The only Tampa Bay area weeds that pollinate primarily in the spring are sorrel and docks (*Rumex*). Dog fennel (*Eupatorium*), even though partially insect pollinated, produces windborne pollen in October and November that is second in quantity only to ragweed. Goldenrod (*Solidago*) blooms in the late summer and fall but is of minor or no importance, since it is primarily insect-pollinated.

Marsh elder (*Iva*) pollen may have contributed to the *Ambrosia* count even though it is confined to coastal salt marshes approximately 30 miles from the sampling site. Cocklebur (*Xanthium*) is exceedingly rare in the Tampa Bay area. Although there is no true nettle (*Urtica*), there were pollens from members of *Urticaceae* family found in this survey, presumably from *Boehmeria, Parietaria*, and/or *Pilea*.

Grasses produce pollen throughout the year in the Tampa Bay area with the greatest production in April through the end of October. In the Tampa Bay area persons sensitive to grass pollen may have symptoms even in the winter months since airborne grass pollen is present all year. The pollen production season for grasses does not extend over the entire season in other parts of the country, except for a few areas in southern Texas and southern California.[1]

In the Tampa Bay area, Bahia grass (*Paspalum notatum*) is a very important aeroallergen.[33] Vasey grass (*P. urvillei*), a member of the same genus as Bahia, produces pollen spring to fall. It is frequently found along roadsides. Natal grass (*Rhynchelytrum repens*) grows abundantly in vacant lots, flowering throughout most of the year. Large stands of Guinea grass (*Panicum maximum*) occur in the summer, particularly in uncultivated citrus groves. Beard grass (*Andropogon spp.*) produces pollen in the fall. The importance of these grasses as aeroallergens is unknown and deserves further study. Pampas grass (*Cortaderia selloana*) is being planted for ornamental purposes around buildings and homes in the Tampa Bay area. It may be or may become an important aeroallergen.[34]

The Rotoslide collector used in this study may be inefficient for particles below 5 to 8 μm so that the small mold spores in the Tampa Bay environment were not reported in this survey. A more thorough investigation using a sampler with broader range, such as the Burkard trap, is necessary for surveying mold spores in this area.[35]

In disagreement with some allergy texts, we have found insignificant amounts of airborne pollen from punk trees (*Melaleuca*) and goldenrod (*Solidago*) and no airborne pollen from Brazilian pepper trees (*Schinus*) nor citrus trees (*Rutaceae*). This is not surprising since these species are insect pollinated.

This survey has established specific seasons in which pollens are produced in the Tampa Bay area. There is overlap among the major pollen seasons, ie, trees (Dec–May), weeds (Apr–Dec), and grasses (Apr–Oct). In addition, mold spores are found throughout the year. Patients with multiple pollen and/or mold sensitivities may have symptoms throughout the year in the Tampa Bay area. More work is required to identify and quantify better airborne mold spores and establish threshold concentrations of mold and pollens required to elicit symptoms in patients suffering from respiratory allergic disease.

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BLISTERS IN CHILDREN

A blistering eruption occurring on a young child with atopic dermatitis is usually one of four vesicular diseases.[1] The differential diagnosis would include impetigo, varicella, herpes zoster and eczema herpeticum (herpes simplex). Physicians should keep in mind that patients with atopic dermatitis are very prone to herpes simplex infections.

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